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more recent date; still, it has become the subject of very general attention. Separate or special chairs devoted to this branch have been created at several of the foreign technical schools, and journals intended for the publication of its distinctive methods and practices have been established. Efforts are now being made to gather in the widely spread literature relating to this subject. The volume before us presents a very full, although not exhaustive, treatment of all the sources of electric energy, the dynamo excepted. The author aims, in this volume, to give a concise account of the various forms of primary batteries and storage cells which have been devised at various times, and adds information in regard to the same which will prove helpful both to those who are engaged in promoting electro-chemical processes and to students who are seeking to gain for themselves as complete a knowledge of this subject as is possible. Some idea of the contents of the volume may be obtained from the following topics: A. Galvanic Batteries: 1. Batteries with one electrolyte. 2. Batteries with two electrolytes. 3. Dry batteries. 4. Normal batteries. 5. Suggestions for the construction of batteries and their components. B. Batteries serving for production of electric energy directly from carbon. C. Gas batteries. D. Thermopiles. E. Accumulators.

The author has treated his subject understandingly and has prepared a work which will prove of great value to all interested in applied electricity. It is his purpose, at an early date, to issue companion volumes, dealing with the application of electricity to metallurgy, to galvanoplastic processes, to chemical analysis and to industrial chemistry. The subject-matter in these later volumes is to be discussed in a thoroughly practical manner.

EDGAR F. SMITH.

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SCIENTIFIC JOURNALS.

AMERICAN JOURNAL OF SCIENCE.

THE April number opens with an extended article by A. M. Mayer, giving the results of a long series of investigations of the phenomena of flotation of disks and rings of metal. The author briefly reviews the early literature on

the subject and notes the erroneous statement often repeated in treatises on physics that a film of grease is necessary to float a piece of metal on a water surface. With respect to this point his results confirm the idea that the film of air which adheres to the body is essential to its floating, since rings of metals, as also rods of glass, sank in water if they had been heated and the air expelled, but regained their power of flotation after being exposed to the air for some 10 or 15 minutes. The disks experimented upon were made of aluminum, but the rings were made also of other metals, as iron, copper, brass, etc. The method of experimenting made possible the accurate determination of the depression of the water surface and also of the weight required to just break it and allow the disks or rings to sink. In the case of the rings the form of the water surface was more complex and called for special investigation. The equation of forces acting upon the disk of aluminum allowed finally of a determination of the surface tension of water, which was found to be .0791 as the mean of three determinations. With rings of different metals the value obtained was .0809. The mean of twenty-eight determinations of this constant by various physicists during the past sixty years is .0772. The surface tension of a solution of sodium chloride of a density of 1.2 was also determined and found to be .0860 (using the value .0772 for water).

George F. Becker contributes a paper on the method of computing diffusion with special reference to the diffusion in the viscous fluids as applied to geological phenomena. This is in connection with an earlier discussion by the same author on rock differentiation, published in the January number. E. O. Hovey discusses the rock of a dike in the Connecticut Triassic area, a few miles east of New Haven. This rock is remarkable in that it departs from the usual diabase character which so remarkably characterizes the Triassic igneous rocks of the entire Atlantic border. It is distinctly acid in character and seems to belong to the group of keratophyres. F. A. Gooch and C. F. Walker discuss the application of iodic acid to the analysis of iodides. The granitic rocks of the Pyramid Peak district in the Sierra Nevadas

of California are described by W. Lindgren. These include granites proper and the granodiorite, which is characterized as an intermediate type, neither a normal diorite nor a granite, but occupying a place between normal quartz-mica-diorite and quartz-monzonite; also normal diorite and gabbro from smaller areas inclosed in granodiorite or granite, or on the contact between them and the schists. It is concluded that all of the granite rocks are later than the altered sedimentary rocks described and the augite-porphyrity, though the relative age of the granite, granodiorite, diorite and gabbro, is not decisively settled. "The probability is that the intrusion both of the granite and of the granodiorite was accompanied by minor intrusions of acid and basic magmas, and that there are diorites, pegmatites and aplites, of the age of the granodiorite and of that of the granite, the latter being the older rock."

R. S. Tarr discusses the difference in the climate of the Greenland and American sides of Davis's and Baffin's Bay. The former name is proposed for the bay between Labrador and Greenland, south of Davis' Straits. When in the Arctic region in the summer of 1896 the author noted the remarkable difference in climate of the two localities, the eastern side being distinctly warmer and at a given time more free from snow and ice than the western. The cause of this is found largely in the ocean current moving northward on the Greenland coast, to which is added the influence of the winds. Remarks are also made on the changes of level of Baffin Land and its relation to glaciation. E. C. Case describes the foramina perforating the cranial region of a Permian reptile. The paper is accompanied by a series of cuts.

John Trowbridge and Theodore W. Richards discuss the temperature and ohmic resistance of gases during the oscillatory electric discharge. The paper gives the result of a series of experiments which have led the authors to conclude that "a mass of gas at low tension contained in a capillary tube may act as though it opposed a resistance of only five or six ohms to the spark of a large condenser." Plücker tubes were employed with aluminum electrodes and the voltmeter allowed of measuring the voltage up to 1,800 volts and above by approximation. A

battery of from five to ten thousand storage cells was employed with a large condenser and a water resistance interposed of from five to fifty megohms. A series of tables give the number of half oscillations corresponding to varying resistances and capacities. Experiments were made with hydrogen and nitrogen gas in particular, and the evidence reached from them is summed up as follows:

"(1) The resistance of a gas at low pressure to the oscillatory discharge is equivalent to only a very small ohmic resistance. (2) This resistance is in general greater the less the quantity of electricity. (3) Down to a very small pressure this resistance decreases with the tension of the gas. (4) The form of the tube has an important effect upon the resistance of the gas. (5) With the oscillatory discharge it is evident that the electrodes produce far less effect than with the continuous discharge." Certain conclusions are also suggested as to the effect of the dissociation in diminishing the resistance of the gas experimented upon, thus tending to explain the difference of the spectra obtained under different conditions. In a following article, discussing whether a vacuum conducts electricity, Trowbridge states that his experiments lead him to believe that "a disruptive discharge of electricity encounters its chief resistance at the going-over layer between the electrodes and the medium, and that during the discharge in a highly rarified medium very little resistance is encountered."

I. C. Russell discusses the plasticity of glacial ice, with reference to recent experiments by McConnell, Kidd and Mügge. The observations made of the optical structure of the ice lead to the conclusion that "the yielding of glacial ice to pressure is due to movements along gliding planes in the granules of which it is composed." The closing article is by O. C. Marsh on the affinities of the Cretaceous bird, *Hesperornis*. He recalls his early conclusions that the *hesperornis* was allied to the ostriches and shows that they are confirmed by the recent discovery of a specimen showing feathers in place and these feathers are the typical plumage of an ostrich. In the notes which follow A. E. Verrill states that in the examination of a mass of the integument from the supposed

octopus cast ashore on the Florida coast, some months since, it has been shown that the mass resembles not an octopus, but rather the substance which forms the head of a sperm whale. The nature of the original animal is still in doubt, since no known species could have yielded a mass of this size, entirely free from any bony structure.

THE ASTROPHYSICAL JOURNAL, FEBRUARY.

The Absorption of Light as a Determining Factor in the Selection of the Size of the Objective for the Great Refractor of the Potsdam Observatory: By H. C. VOGEL. The author discusses the effect of absorption upon the 'light-grasping power' of objectives of various apertures. The first part of the paper deals with the experiments for the determination of the absorption of the various varieties of glass available for large objectives. The second part consists of the application of the constants thus obtained to the determination of dimensions. Assuming the ratio of diameter of lens to thickness to be between six and seven, it is shown that an increase in aperture above 80 cm. gives very little corresponding increase of light. This is due to the additional absorption which is entailed by the increased thickness. An increase in diameter from 35 cm. to 80 cm. multiplies the light-gathering power by four, while a further increase to 100 cm. adds another factor of only 1.4. In view of the rapid increase in cost of a telescope, corresponding to an increase in size, and the smallness of this last factor, Dr. Vogel considers 80 cm. as about the most economical diameter. As the telescope is to be used chiefly for astrophysical work, it is to be corrected for photographic rays, and it is the absorption of these which determined the dimensions. The life partner of the great refractor is to be a visually corrected finder of 50 cm. aperture.

The Spectrum of Puppis: By E. C. PICKERING. As was announced in *H. C. O. Circular*, No. 12 (Ap. J., Dec., 1896), the spectrum of Puppis contains two rythmical systems of dark lines, one being the known series due to hydrogen. It was also announced that the other series is governed by a law somewhat resembling Balmer's law for hydrogen. In the present

paper the writer points out that by a modification, Balmer's formula may be made to satisfy both series. The formula as ordinarily written

(for Rowland's scale) is $\lambda = 3646.1 \frac{m^2}{m^2 - 4}$, where

$m = 3, 4, 5, 6$, etc., substituting $\frac{1}{2}n = m$ we obtain $\lambda = 3646.1 \frac{n^2}{n^2 - 16}$, which gives the hydro-

gen lines when $n = 6, 8, 10, 12$, etc., and the lines of the newly discovered series when $n = 5, 7, 9, 11$, etc. In the light of this remarkable relation it seems probable that the new series is, in fact, due to hydrogen under some physical condition so far unknown upon our globe.

On the Spectrum of Puppis: By H. KAYSER. In connection with this spectrum Professor Kayser calls attention to the fact that hydrogen is the only element which has, until now, been considered to have only one series of lines. In every other case where series have been found to exist, there are two converging approximately to the same limit, each satisfying a formula of the type $\frac{1}{\lambda} = A - Bm^{-2} - Cm^{-4}$ where $m = 3, 4, 5, 6$, etc. The alkali metals have in addition a third series, brighter than these two. It has been generally supposed heretofore that the ordinary hydrogen spectrum consisted of this series. Certain considerations however seemed to contradict this. The newly found series in Puppis now fits in very neatly, converging approximately to the same point as does the old one. In the light of these developments more accurate measurements of the positions of the new lines will be of great interest.

On the Effect of Pressure in the Surrounding Gas on the Temperature of the Crater of an Electric Arc. Correction of Results in Former Paper: By W. E. WILSON and G. F. FITZGERALD. "The primary object of this research was to determine, if possible, whether the temperature of the crater in the positive carbon varies when the pressure in the surrounding gas is changed." The result is interesting as bearing directly upon the mooted question as to whether the temperature of the crater is that of boiling carbon. If such were the case we should expect a rise in the temperature of the crater with in-

creased pressure, corresponding to a rise in the boiling point of carbon. The radiation from the crater was measured with a radiomicrometer. Since the radiation varies as the fourth power of the temperature, a slight change in the latter should be noticeable. The experiments were not definitive, on account of the many difficulties encountered, but seemed to show that the temperature remained constant throughout a range of pressure of from one to seven atmospheres. At any rate, the constancy was sufficient to practically disprove the boiling-point idea. Among the chief difficulties to be met were connection currents in the apparatus, which rendered the gases so opaque as to suggest to the writers a new explanation of sun spots. The paper has the additional interest of indicating that temperature effects can not play an important part in the shifting of lines in metallic spectra when pressure is applied to the arc.

Preliminary Table of Solar Spectrum Wavelengths, XVII.: By HENRY A. ROWLAND.

On the Comparative Value of Refracting and Reflecting Telescopes for Astrophysical Investigations: By GEORGE E. HALE. The paper, as is indicated by the title, is a discussion of the relative merits of the two forms of instruments mentioned. In addition to economy, freedom from chromatic aberration, and other advantages sometimes urged in favor of reflectors, Professor Hale brings forward that of their relative freedom from absorption. The effect of this in large refractors is discussed in the above paper by Dr. Vogel, and is shown to increase with the size. Since the percentage of absorption of a reflector is independent of its dimensions, this factor is of great importance where large apertures are concerned. The paper is accompanied by an interesting diagram, which shows, among other things, that for linear apertures greater than 90 cm. the *photographic* [light-gathering power of a reflector exceeds that of a refractor.

On a New Form of Mounting for Reflecting Telescopes Devised by the Late Arthur Cowper Ranyard: By F. L. O. WADSWORTH. The writer discusses some developments of the idea of the Cassegrainian Condé proposed by Mr. Ranyard. Several forms of mounting are considered. In every case, with one exception,

the polar axis is of the fork type. A mirror at the intersection of the polar and declination axis is so arranged that its plane always bisects the angle between the telescope and polar axis, so that light from the small convex mirror is always thrown up or down the polar axis (which is hollow), as may be desired.

A Support System for Large Specula: By G. W. RITCHEY. In this article Mr. Ritchey describes a support system designed to reduce to a minimum the effects of flexure in large mirrors. The system is in reality a double one: 1. The back support. 2. The edge support. In the first system the mirror is considered as divided, by cylindrical surfaces perpendicular to the back of the mirror, into twelve parts of equal mass. Each part rests upon a support. Nine of these supports are counterbalanced in all positions by weighted levers, while the remaining three rest upon the cell. It is evident that if all twelve supports were counterbalanced the mirror would be in equilibrium in any position close to its normal one. If three of the supports are fixed, however, the nine remaining counterweights will be unable to take any of the weight off of the fixed supports which will, therefore, determine the plane of the mirror. The mirror will, therefore, *float* in a fixed plane. The edge support is designed upon the same general principles. There is reason to believe that the plan will combine with a perfect flotation support, a degree of stability heretofore unattained in speculum mounting.

Oxygen in the Sun: By LEWIS E. JEWELL. See foot-note to abstract of App. J, December, 1896, in SCIENCE, March 19th.

Minor Contributions and Notes, Reviews, Bibliography.

SOCIETIES AND ACADEMIES.

ZOOLOGICAL CLUB, UNIVERSITY OF CHICAGO,
MEETING FEBRUARY 10.

ABSTRACTS OF PAPERS PRESENTED.

*On the Morphology of the Skull of the Pelycosauria and the Origin of the Mammals.** By G. BAUR and E. C. CASE.

*A fuller account of this paper has just been published in *Anatom. Anzeiger*, XIII. Band., No. 2 and 5, January 30, 1897, pp. 109-120, with three figures of the skull.